

# Joint Trauma System



## Whole Blood Transfusion

*Part of the Joint Trauma System (JTS) Clinical Practice Guideline (CPG) Training Series*



# Purpose



This CPG provides the rationale and guidelines for whole blood (WB) transfusion, including but not limited to product definitions, indications, collection, storage, testing, transfusion, and documentation.

*Presentation is based on the JTS Whole Blood Transfusion CPG, 15 May 2018 (ID: 21). It is a high-level review. Please refer to the complete CPG for detailed instructions. Information contained in this presentation is only a guideline and not a substitute for clinical judgment.*

# Agenda

1. Summary
2. Background
3. Definitions
4. Using Whole Blood (WB)
5. Using Low Titer O Whole Blood
6. WB Benefits, Risks
7. Walking Blood Bank (WBB)
8. Special Considerations
9. Performance Improvement (PI) Monitoring
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*Courtesy of Defense Visual Information Distribution Service.*

# Summary

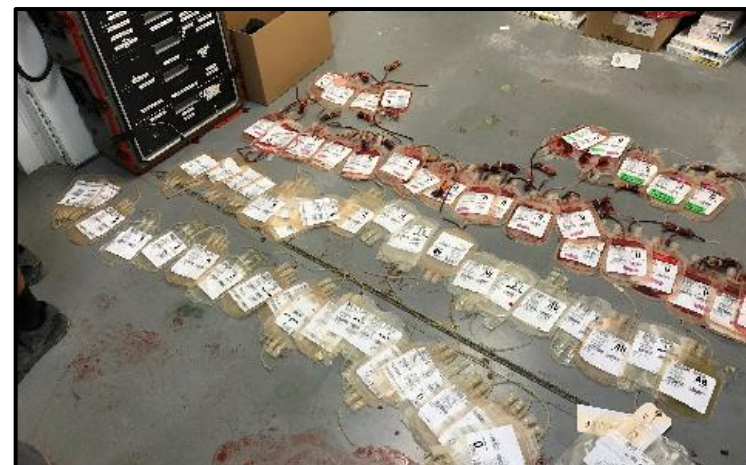


- Whole blood, and in particular, low-titer-O whole blood, is the preferred resuscitation product for the pre-hospital treatment of patients in hemorrhagic shock.
- Fresh whole blood should be reserved for casualties, when stored whole blood or optimal component therapy is unavailable, or stored component therapy is not adequate.

# Background

**Whole blood transfusion to treat hemorrhage results in outcomes that are at least as favorable as expected outcomes with component therapy.**

- **Component therapy** is nearly equivalent to whole blood when administered in a 1:1:1 ratio (platelets:plasma:RBC).
  - ❑ Multiple products and storage modalities required.
  - ❑ Delivers a dilute blood mixture due to presence of anticoagulants and red cell additive solution.



Component therapy for a massive transfusion

# Background

## Whole blood provides a physiologic blood mixture.

- Single product requiring only one storage modality.
- At least one study has shown a survival benefit of fresh whole blood over component therapy.



**Training to save lives.**

*Photo by Lance Cpl. Ashley Lawson, Courtesy of Defense Visual Information Distribution Service.*

# Definition: Whole Blood



## Whole Blood:

- Collected in anticoagulants CPG (21 day use) or CPDA-1 (35 day use) and stored at 1-6°C.
- FDA approved when appropriately collected, stored, and tested for transfusion-transmitted disease.
- Contains all components of blood products, with smaller volume of anticoagulant, and maintains in-vitro hemostatic capability for two weeks in storage.



# Definition: Fresh Whole Blood

## Fresh Whole Blood (FWB)

- Blood collected on an emergency basis from a “walking blood bank.”
- Stored at room temperature and useable within 24 hours.
- If stored within eight hours in appropriate refrigeration, becomes Stored Whole Blood (WBB-SWB) – good for 21 to 35 days, depending on anticoagulant.



**Walking Whole Blood Bank**

*Photo courtesy of Defense Visual Information  
Distribution Service*



# Definition: Low Titer O Blood



## Low Titer O Blood (LTOWB)

- Patients with low Anti-A and Anti-B antibodies (< 1:256 saline dilution).
- Preferred resuscitation product for the pre-hospital treatment of patients.
- Donors should be re-titered every 90 days, but given limitations of battlefield testing, titering prior to deployment or least annually acceptable.

# Using Whole Blood



- Stored Whole Blood (SWB) is the preferred product for resuscitation.
  - ❑ In practice, LTOWB, is most commonly collected and used.
- SWB or component therapy in appropriate ratio can be used for damage control resuscitation.
- FWB should be reserved for casualties with clinically significant shock/coagulopathy when SWB or optimal component therapy is unavailable.
  - ❑ Appropriate when stored component therapy does not adequately resuscitate a patient with life-threatening injuries.
  - ❑ Rh negative blood should ideally be given to females of child-bearing age who are Rh negative.

# Using Whole Blood



- If given whole blood, patients with an unknown blood group will require LTOWB or group O red blood cells for any acute transfusion requirements for 1 month
  - Impossible to definitively identify blood group with field equipment if blood tested after patient receives LTOWB.
- Rh negative blood should ideally be given to females of child-bearing age who are Rh negative.

# Using LTOWB



- Low Titer O Whole Blood or group O red blood cells will be given to patients with an unknown blood group receiving whole blood.
- ❑ Obtaining pre-transfusion blood sample can establish patient's original blood group.
- ❑ Once patient receives LTOWB, impossible to definitively identify blood group with field equipment.
- ❑ These patients will therefore require LTOWB or group O red blood cells for any acute transfusion requirements for up to one month after admission.

# Whole Blood Benefits



## Fresh Whole Blood: Benefits

- Used when other blood products cannot be delivered at an acceptable rate to sustain resuscitative efforts.
- No identified degradation in donor performance.
- May be more readily available than SWB.

# Whole Blood Risks



## Fresh Whole Blood: Specific Risks

- Increased risk of transfusion-transmitted infections
  - ☐ Possible case of transmission of Hepatitis C
  - ☐ One possible Human T-Lymphocyte Virus seroconversion
- Increased risk of clerical errors
  - ☐ One fatal case of graft vs host disease
- Unsanitary conditions in field.
- Not FDA approved

# Walking Blood Bank

## WBB Program should be established at all forward-deployed medical treatment facilities (MTF)

- WBB used to collect FWB.
- Requires identification and pre-screening of donors.
- Coordination required with the Area Joint Blood Program Officer (AJBPO).
- Follows specific guidelines for pre-screening of donors and collecting whole blood in only authorized equipment (See CPG for standard operating procedures and WBB Supply List.)



Preferred donors for FWB are pre-screened.  
*Photo by Petty Officer 2nd Class Charles Oki, Courtesy of Defense Visual Information Distribution Service.*



# Walking Blood Bank



## WBB Ideal Donors

- Preferably composed of active duty/guard/reserves and other DoD beneficiaries.
- Fully pre-screened, Low Titer O donor.
  - Group-specific donors may be appropriate for group-specific transfusion (e.g., A to A).
  - Group O FWB of unknown titer safer than attempting to match donor-recipient blood group in emergency situations.

# Walking Blood Bank



## Decision to use FWB

- Not completely screened to international and national standards.
- Used only after thorough consideration of risks and benefits.
- Must be thoroughly documented in casualty record.
- Blood type on identification tags is about 4% inaccurate.
- Coalition forces are not routinely utilized as donors;
- Non-coalition force foreign nationals are used as a last resort.

# Walking Blood Bank



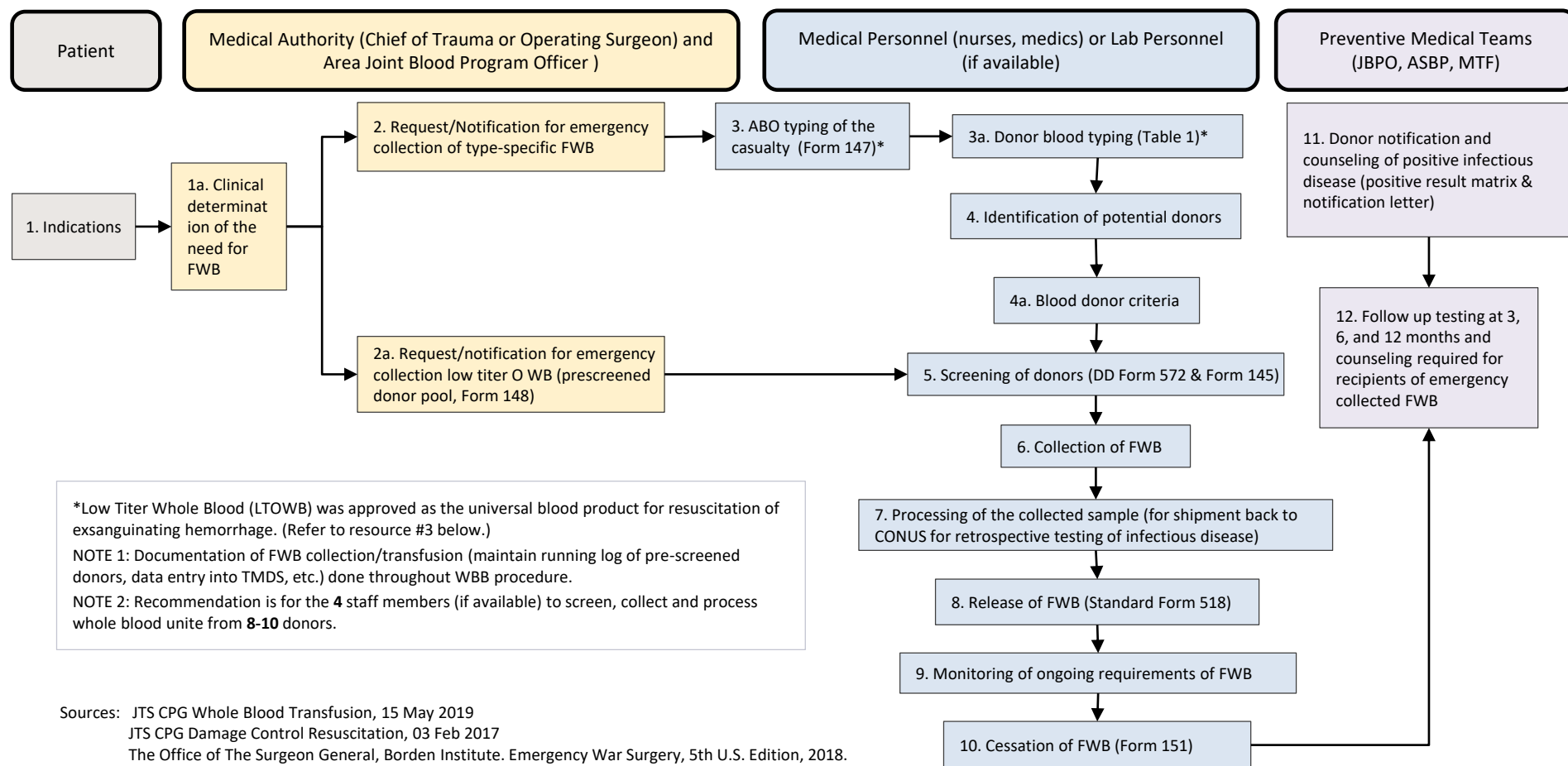
## **Theater Medical Data Stores (TMDS) will be used to record donations and disease testing results.**

- Prior to issuing FWB, blood type and approved rapid infection disease tests should be performed.
- Retrospective samples must be sent to a licensed laboratory for FDA-approved testing regardless of in-theater results.
  - ❑ FWB recipients will have follow-up advice and testing as soon as possible and at 3, 6 and 12 months post transfusion.
  - ❑ Positive infectious disease results require informing the donor and recipient.

## **Frequency of FWB donation must be tracked**

- WB units should not be collected from donors more frequently than every eight weeks to prevent injury to donor.
- One unit collected per donor. Maximum of two in dire situations.

# Walking Blood Bank



# Special Considerations



## Whole Blood and Pediatric Patients

- Whole blood has been administered to pediatric patients in recent conflicts, but has not been rigorously studied.
- There are no known contraindications, but no firmly established clinical criteria exist for transfusion.
- Recommendations include:
  - ❑ For patients < 40 kg, WB should be delivered in unit doses of 10-15 ml/kg.
  - ❑ Physiologic variables should be interpreted by age.

## ■ Intent (Expected Outcomes)

- ❑ SWB, particularly LTOWB, is used when available for pre-hospital resuscitation.
- ❑ SWB or component therapy is routinely used for damage control resuscitation; FWB is reserved for casualties who meet one of these two criteria:
  1. Patients with clinically significant shock or coagulopathy (e.g., bleeding with associated metabolic acidosis, thrombocytopenia or INR >1.5) when SWB or optimal component therapy (e.g., PLTs and FFP) are unavailable.
  2. SWB or component therapy is not adequately resuscitating a patient with immediately life-threatening injuries.

# Performance Improvement Monitoring



## ■ Performance/Adherence Measures

- ☐ SWB was used in prehospital resuscitation.
- ☐ SWB or component therapy was routinely used for damage control resuscitation.
- ☐ FWB was used for casualties who fall into one of these two criteria:
  1. Patients with clinically significant shock or coagulopathy (e.g., bleeding with associated metabolic acidosis, thrombocytopenia or INR >1.5) when SWB or optimal component therapy (e.g., PLTs and FFP) was unavailable;
  2. SWB or component therapy was not adequately resuscitating the patient with immediately life-threatening injuries.

## ■ Data Source

- ☐ Patient Record
- ☐ DoD Trauma Registry
- ☐ Blood transfusion databases



# References (1)



1. Pidcock HF, McFaul SJ, Ramasubramanian AK, et al. Primary hemostatic capacity of whole blood: a comprehensive analysis of pathogen reduction and refrigeration effects over time. *Transfusion*. 2013 Jan;53 Suppl 1:137S-149S.
2. Strandenes G, Berséus O, Cap AP, et al. Low titer group O whole blood in emergency situations. *Shock*. 2014 May;41 Suppl 1:70-5.
3. Fisher AD, Miles EA, Cap AP, Strandenes G, Kane SF. Tactical Damage Control Resuscitation. *Mil Med*. 2015 Aug;180(8):869-75. doi: 10.7205/MILMED-D-14-00721.
4. Yazer MH, Cap AP, Spinella PC. Raising the Standards on Whole Blood. *J Trauma Acute Care Surg*. 2017 Dec 28
5. Butler FK, Holcomb JB, Schreiber MA, et al. Fluid Resuscitation for Hemorrhagic Shock in Tactical Combat Casualty Care: TCCC Guidelines Change 14-01--2 June 2014. *J Spec Oper Med*. 2014 Fall;14(3):13-38.
6. Spinella PC, Cap AP. Whole blood: back to the future. *Curr Opin Hematol*. 2016 Nov;23(6):536-542.
7. Arya RC, Wander GS, and Gupta, P. Blood component therapy: Which, when and how much. *J Anaesthesiol Clin Pharmacol*. 2011 Apr-Jun; 27(2): 278–284.
8. Stansbury LG, Hess JR. The 100th anniversary of the first blood bank. *Transfusion*. 2017 Nov;57(11):2562-2563.
9. Pidcock HF, Aden JK, Mora AG, et al. Ten-year analysis of transfusion in Operation Iraqi Freedom and Operation Enduring Freedom: increased plasma and platelet use correlates with improved survival. *J Trauma Acute Care Surg*. 2012 Dec;73(6 Suppl 5):S445-52.
10. Holcomb JB, Tilley BC, Baraniuk S, et al. Transfusion of plasma, platelets, and red blood cells in a 1:1:1 vs a 1:1:2 ratio and mortality in patients with severe trauma: the PROPPR randomized clinical trial. PROPPR Study Group. *JAMA*. 2015 Feb 3;313(5):471-82.
11. Spinella PC, Perkins JG, Grathwohl JG, et al. Warm fresh whole blood is independently associated with improved survival for patients with combat-related traumatic injuries. *J Trauma*. 2009;66:S69-S76.
12. Perkins JG, Cap AP, Spinella PC, et al. Comparison of platelet transfusion as fresh whole blood versus apheresis platelets for massively transfused combat trauma patients (CME). *Transfusion*. 2011 Feb;51(2):242-52.
13. Hess JR. Resuscitation of trauma-induced coagulopathy. *Hematology Am Soc Hematol Educ Program*. 2013;2013:664-7.
14. Strandenes G, De Pasquale M, Cap AP, et al. Emergency whole-blood use in the field: a simplified protocol for collection and transfusion. *Shock*. 2014 May;41 Suppl 1:76-83.

## References (2)



15. Doughty H, Thompson P, Cap AP, et al. A proposed field emergency donor panel questionnaire and triage tool. *Transfusion*. 2016 Apr;56 Suppl 2:S119-27.
16. Hess JR. Measures of stored red blood cell quality. *Vox Sang*. 2014 Jul;107(1):1-9.
17. Belpulsi D, Spitalnik SL, Hod EA. The controversy over the age of blood: what do the clinical trials really teach us? *Blood Transfus*. 2017 Mar;15(2):112-115.
18. Strandenes G, Skogrand H, Spinella PC, et al. Donor performance of combat readiness skills of special forces soldiers are maintained immediately after whole blood donation: a study to support the development of a prehospital fresh whole blood transfusion program. *Transfusion*. 2013 Mar;53(3):526-30.
19. Nessen SC, Eastridge BJ, Cronk D, et al. Fresh whole blood use by forward surgical teams in Afghanistan is associated with improved survival compared to component therapy without platelets. *Transfusion*. 2013 Jan;53 Suppl 1:107S-113S.
20. Rentas FJ1, Clark PA. Blood type discrepancies on military identification cards and tags: a readiness concern in the U.S. Army. *Mil Med*. 1999 Nov;164(11):785-7.
21. Frohman EM. Blood typing errors on U.S. Army identification cards and tags. *Mil Med*. 1989 May;154(5):273-4.
22. Gaydos JC, Polk AJ, Cowan DN, et al. Blood typing errors on U.S. Army identification (ID) cards and tags. *Mil Med*. 1990 Apr;155(4):A19.
23. Mast AE, Bialkowski W, Bryant BJ, Wright DJ, Birch R, Kiss JE, D'Andrea P, Cable RG, Spencer BR. A randomized, blinded, placebo-controlled trial of education and iron supplementation for mitigation of iron deficiency in regular blood donors. *Transfusion* 2016;56:1588-1597. PMID: 26813849
24. Bialkowski W, Kiss JE, Wright DJ, Cable RG, Birch R, D'Andrea P, Bryant BJ, Spencer BR, Mast AE. Estimates of total body iron indicate 19 mg and 38 mg oral iron are equivalent for the mitigation of iron deficiency in a longitudinal study. *American Journal of Hematology* 2017; 92:851-857. PMID: 28494509).
25. Repine TB, Perkins JG, Kauvar DS, Blackburne L. The use of fresh whole blood in massive transfusion. *J Trauma*. 2006;60:S59-S69.

# Appendices in CPG



- **Appendix A:** Walking Blood Bank Process Map
- **Appendix B:** Blood Donor Pre-Screening SOP
- **Appendix C:** Emergency Whole Blood Collection SOP
- **Appendix D:** Additional Information Regarding Off-Label Uses in CPGs

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